

THE INSTITUTE OF PHYSICS

47 BELGRAVE SQUARE, LONDON, S.W.1.

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*The Bulletin is not intended for general circulation :
your copy should not therefore be passed to a library.*

APPOINTMENTS VACANT

The inclusion of particulars of a vacancy must not be taken to imply that the Institute necessarily approves of the terms offered or that might be offered. Candidates should satisfy themselves that these are satisfactory, and they may always refer to the Institute for advice.

Physicists required for a laboratory situated in Northamptonshire. Preference will be given to applicants who have experience in semi-conductors, ferro-magnetics, ferro-electrics, electronics or crystal growing. Salary will depend on qualifications and experience. Box A.V.53, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

Physicists and Chemists required for research in the field of semi-conductors, including photo-cell development and study of intermetallic compounds. Men of Ph.D. standing, or graduates with some relevant research experience preferred. Location: Northamptonshire. Box A.V.54, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

Ferranti Ltd., Edinburgh, have a vacancy in their Applications Laboratory for an **Engineer-Physicist** for interesting development work with a control project opening up a new field and involving digital computers, data recording and servo-mechanisms. A degree or equivalent in electrical engineering or physics is essential, and experience in some, or all, of these fields is desirable. The appointment is permanent and offers excellent prospects in an expanding organization. A salary commensurate with the qualifications required for this position will be paid. Good conditions, Staff Pension Scheme. Apply giving full details of training, qualifications and experience and quoting Ref. EP/AL to the Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh, 5.

Department of Scientific and Industrial Research require **Scientific Officers** (unestablished) at the **National Physical Laboratory**, Teddington, for work in the following subjects:—Physics (including radiology), Mechanical and Electrical Engineering, Mathematics, Aerodynamics, Chemistry (Metallurgical Analysis). Applicants must have 1st or 2nd class honours degree in a suitable scientific subject or equivalent qualification. Inclusive annual remuneration for a 45½-hr. week: (men) £475-£877, (women) £475-£764. Prospect of permanent pensionable post for candidates under 28. Application forms from M.L.N.S. Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A351/53A. Closing date February 24, 1954.

University of Western Australia. Applications are invited for the newly created position of **Reader in Theoretical Physics**. The initial appointment will be for five years.

The salary range is £A1,250 × £50 - £1,450 per annum to which is added a cost of living allowance of £A259 (gross salary £A1,509 × £50 - £A1,709). According to qualifications an appointment may be made within the range. Applicants should have high academic qualifications and have undertaken research in theoretical physics, preferably in quantum theory. Some teaching experience is desirable.

An allowance is made towards travelling expenses.

Further particulars and information as to the method of application should be obtained from the Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1.

The closing date for the receipt of applications in London and Australia, is March 22, 1954.

Dunlop Research Centre offer appointments for several research assistants for work involving the application of modern physical techniques to interesting problems connected with the rubber industry. Applicants should have completed National Service. The minimum educational standard required for the junior appointments is G.C.E. advanced level in physics and mathematics. For the more senior appointments, degree level qualifications are necessary. Applications in writing, giving age, qualifications and experience, and quoting J.M.29 to Personnel Manager, Dunlop Rubber Co. Ltd., Fort Dunlop Birmingham, 24.

Physicist. A major need for this appointment is the trained habit of analytical enquiry which takes nothing for granted, weighs the factors, and firms the findings before proceeding to the next logical step. A world-famous textile organization in the North Midlands wants such a graduate physicist, honours degree of Ph.D., aged up to 27, to join its research project into manufacturing problems on the shop floor. This is a field in which there is ample scope for stimulating and rewarding work. Previous industrial experience is unnecessary. The post is permanent and pensionable, with a good initial salary and plenty of room for progress. Please write for official form of application and further details to Box A.V.55, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

South East London Technical College. **Senior Lecturer** required from May 1, 1954, to teach and develop the subject of Electronics. Applicants should be graduates and have good experience in Industrial Electronics. Salary (present) Burnham Technical scale, £1,040 × £25 - £1,190 plus London allowance. Application forms obtainable from the Secretary of the College should be returned by Monday, February 15, 1954.

Department of Scientific and Industrial Research require **Scientific Officers** (unestablished) at the **Mechanical Engineering Research Laboratory**, East Kilbride, as follows:—1. Mathematician or Mechanical Engineer for work on stress distribution and fatigue problems (Ref. C.16/54A). 2. Electrical Engineer or Physicist for work on application of noise control techniques to the suppression of noise in machinery. Experience in use of microphones or pick-ups and knowledge of wave form analysis would be an advantage (Ref. D.20/54A). 3. Physicist or Physical Chemist with sound knowledge of classical thermodynamics for preparation of thermodynamic tables (Ref. A.11/54A). 4. Engineer or Physicist for investigation into the fundamental mechanism of plastic deformation of materials. Experience with electronic instruments desirable. (Ref. A.12/54A). Applicants must have 1st or 2nd class honours degree in a suitable scientific subject or equivalent qualifications. Inclusive annual remuneration for a 45½ hour week: (men) £430 - £804, (women) £430 - £696. Prospect of permanent pensionable post for candidates under 28. Favourable housing prospects exist for married staff. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting appropriate reference. Closing date February 26, 1954.

(Continued on page iii)

THE RECOGNITION OF TECHNICAL COLLEGES

During the past year the physics departments of seven technical colleges have been described in the *Bulletin*. These articles were invited because it was thought they would be helpful to teachers in smaller technical colleges and schools and also because many physicists and others in industry and government services are almost unaware of the facilities which exist in technical institutions. For several years the Institute has taken every opportunity to direct attention to the need for improving and developing technical education in this country. It has published reports on the subject, and has provided many opportunities, through its Education Group and otherwise, for the discussion of problems of technical education. Accounts of the proceedings of several of these discussions have been published in the Institute's journals or in the *Bulletin*.

An effective contribution to the improvement of technical college facilities in physics has been made by the Institute's system of granting recognition for the purpose of its membership regulations to certain colleges. To be recognized, colleges must be considered to have the necessary facilities to provide sound and thorough training in physics up to a standard required for compliance with the Institute's academic requirements for Graduateship. A list of approved colleges is included in the handbook of membership regulations and students who inquire from the Institute about courses of study are always recommended to enter one of these colleges if geographical and other conditions make this possible. Further, save in exceptional circumstances, a student who has obtained an external degree of the University of London or a Certificate which would otherwise be acceptable to the Institute, will not be considered eligible for any grade of membership implying professional status unless he has followed a course at an institution which has been recognized by the Institute. It was for this reason that the regulations were changed a few years ago to include the requirement that a candidate must have been "regularly educated as a physicist in a manner satisfactory to the Board" before being eligible for Associateship or Fellowship. The Board was anxious to make clear its opinion that the passing of an examination is not sufficient evidence of the thoroughness of training which a physicist should have. Those who have taught in universities and the major technical institutions recognize that much that is essential to an

intending physicist cannot be covered by the examination and, therefore, that a course of study designed merely for examination success may have serious omissions.

When the system of recognition was introduced in 1947 a list of eighteen technical colleges which could be recognized without inspection was agreed. Since then each college seeking recognition has been visited by three representatives of the Institute, accompanied by one of Her Majesty's Inspectors, and a decision made in the light of their report. In order to try to preserve a consistent standard with different representatives, the Deputy Secretary of the Institute has been one of the representatives in every instance. The Institute is glad to record its indebtedness to Her Majesty's Inspectors for their unfailing helpfulness and for their recognition that this system of inspection, although quite unofficial, has produced some valuable results. On each of the visits the Inspector goes merely to advise the Institute's representatives and he is in no way responsible for the report which is produced.

The number of colleges now recognized is forty-two. Some of them are provisionally recognized for two or three years only and continued recognition will depend upon the implementing of recommendations made to the Principals. Several colleges have been refused recognition and a few have been recognized only after a second visit and when recommended improvements had been effected. It should be stressed that the Institute is concerned only to improve any facilities that may be unsatisfactory and that it is anxious to give every assistance to Principals and staff in obtaining these improvements.

After a visit, the representatives report in some detail to the Membership and Examinations Committee and, with the approval of the Board of the Institute, selected extracts from the report are submitted to the Principal of the college. With only one exception, Principals have welcomed these comments, even when they have contained serious criticisms of the accommodation or equipment available. The Institute's report has often been of great value to a Principal in adding weight to recommendations which he may already have made, over a period of years, to his governors or local education authority. In almost all cases useful improvements have resulted and in one or two colleges the results have been quite outstanding, involving expenditure of some thousands of pounds on new apparatus or accommodation.

The Membership and Examinations Committee has never taken an unrealistic attitude towards the facilities which may be expected in technical colleges in the present circumstances of overcrowding and difficulty. Several technical college Principals and Heads of Departments have served on the Committee over the past few years and have given valuable advice which would have prevented, had this have been

necessary, any demands from the Institute for quite impracticable changes in colleges. At the same time, the Institute has not hesitated to make, as a condition of recognition, a proposal for the provision of new laboratories, apparatus or staff when these have seemed necessary. The results have fully justified the Institute's point of view. One point that should perhaps be specially mentioned is the Membership and Examinations Committee's insistence that physics departments in colleges should be provided with adequate workshops competently staffed and under their own control.

In its report *Problems Concerning the Education of Physicists* the Institute stated that "the distinction between the functions of the universities and the technical colleges should be more clearly and more widely recognized. In our opinion, some technical colleges have been deflected from their own important field in order to train students for external university degrees. There is however a very real difference, which is perhaps not sufficiently widely understood, between the major technical colleges and the smaller institutions. Some of the major colleges, among which are a number of the London polytechnics, are very well equipped for teaching physics and they should provide courses of university standard, although not identical in content with undergraduate courses in the universities. . . . Most of the technical colleges in this country, however, are not adequately equipped for advanced work in physics and we feel that they would be more adequately fulfilling their real function by offering courses such as those for the National Certificates in Applied Physics." In discussions with teachers during visits to colleges the Institute's representatives have tried to encourage the development of courses in the way suggested in this quotation. In most of the technical colleges in the country it is only in the last few years that there has been any demand for courses in physics other than as ancillary courses for awards in engineering or building. The pressure on the universities and the greatly enhanced importance of applied physics created in many quite small institutions a demand for advanced courses in physics. A large number of colleges have introduced degree courses during the post-war years ; usually the courses lead to the General degree of the University of London with physics as one subject. It is natural that physics teachers in even the smaller colleges should wish to have a proportion of advanced work in the subject but it is widely agreed that most of these colleges would be doing more valuable work if they were to develop courses in applied physics rather than attempt university work. The Ordinary and Higher National Certificates in Applied Physics offer an excellent opportunity of developing advanced courses particularly suited to the needs of industry and to the traditional function of the technical colleges in catering for the part-time student.

It may be mentioned that at least two colleges recognized by the Institute provide no courses for first degrees in physics but both have well established courses for the Higher National Certificate in Applied Physics and regular series of post-graduate lectures in applied physics. It should be clear, therefore, that the Institute does not regard the provision of degree courses as essential before recognition can be given.

N.C.

NOTICES TO MEMBERS

Honours List

The names of the following Fellows of the Institute were included in the New Year Honours List with the awards shown :—

C.H.	-	-	-	J. Christie
Knight Bachelor	-	-	-	E. T. Paris
O.B.E.	-	-	-	A. G. Tarrant
M.B.E.	-	-	-	W. H. F. Griffiths

Further Gifts to the Furnishing Fund

At the Board meeting held on January 19 it was announced that Mr. O. W. Humphreys on behalf of the Research Laboratories of The General Electric Co., Ltd., had offered to present a set of Board room tables to the Institute. The Board accepted this gift with very much pleasure. The set will consist of eight specially made tables for use by the Board and the many Committees which meet in the House. They will also be suitable for use at the various social functions arranged from time to time by the Groups, the London Branch and by the President for distinguished visitors.

The anonymous gift of £600 to the furnishing fund announced in the December *Bulletin* was also referred to at the Board meeting, when it was stated that it could now be disclosed that the donors were the Brown-Firth Research Laboratories, through the President Dr. C. Sykes. The greater part of this gift is also being spent on furnishing the newly decorated Board room.

The plans made for refurnishing other rooms used by members, must await further gifts to the Furnishing Fund, as the Board believes that sufficient of the Institute's limited capital has been spent on the House for the present.

Inquiry into the Occupations of Graduates

The Institute is conducting an inquiry into the types of post taken up by graduates in physics immediately after obtaining their degrees. In recent years there have often been calls for information concerning the distribution of new entrants among various branches of the profession. No reliable information appears to have been available

and the Board has therefore decided to make this inquiry. Inquiry cards have been sent to all new graduates whose names have been supplied by universities and it is intended to make further inquiries in each of the next few years. Subject to the approval of the Board, a report on the inquiry will be published in the *Bulletin*.

Graduateship Examination 1954

The Institute's Graduateship Examination will be held from June 21 to 25 next. The examination centres are London (the Institute's House), Birmingham (College of Technology) and Paisley (Technical College). More than seventy candidates have been accepted for the whole or part of the examination.

Full details of the regulations and syllabuses of the Graduateship Examination may be obtained from the Deputy Secretary of the Institute.

Education Group Conference

It has been necessary to change the dates of the annual conference of the Education Group from those given on page 10 of the January *Bulletin*. The conference will be held on April 13 and 14 at the Institute's House.

List of Members

The list of members, as at July 1, 1953, will be published in March. One copy will be supplied to each member of any grade of the Institute, free of charge on request.

The 1954 Physical Society Exhibition

The Physical Society Exhibition will be held at Imperial College, South Kensington, London, S.W.7, on the following dates.

Thursday, 8th April.	10 a.m. to 8 p.m. (<i>Fellows of the Society and Press only, 10 a.m. to 2 p.m.</i>)
Friday, 9th April.	10 a.m. to 8 p.m.
Saturday, 10th April.	10 a.m. to 5 p.m.
Monday, 12th April.	10 a.m. to 8 p.m.
Tuesday, 13th April.	10 a.m. to 5 p.m.

This year the Exhibition is confined to the Imperial College of Science and Technology main building in Imperial Institute Road.

The tickets are split into four groups as follows :

1. Whole day tickets which are available for any one day of the Exhibition.
2. Season tickets which can be used on all three evenings on which the Exhibition is open.
3. Morning tickets which can be used on any one morning.

4. Tickets are also available which give admission on Saturday only.

As in previous years a limited number of tickets will be available from the Institute for members who are not members of the Society. Application should be made as soon as possible.

Scholarships Abroad 1954-55

Younger members of the Institute may be interested in a booklet recently issued by the British Council entitled *Scholarships Abroad 1954-55*. It contains details of scholarships offered to British students by foreign governments and universities. Copies may be obtained gratis from the British Council at 65 Davies Street, London, W.1, or any of its regional offices.

Message to Russian Crystallographers

The following letter was sent in December to Dr. A. V. Shubnikov of the Soviet Academy of Sciences :—

“ Dear Dr. Shubnikov,

This is to convey cordial greetings from British crystallographers on the occasion of the centenary on the 10th December, 1953, of the birth of Federov, whose work in the field of crystallography is well-remembered and valued here. Please accept our sincere good wishes for the success of the celebration meetings which you have arranged at the Institute of Crystallography and the Leningrad Mining Institute.

Yours sincerely,

H. P. ROOKSBY,

Chairman of the X-ray Analysis
Group of the Institute of Physics.”

Symposium on Molecular Structure and Spectroscopy

The Symposium on Molecular Structure and Spectroscopy will be held at the Department of Physics and Astronomy, the Ohio State University, this year from June 14 to June 18, 1954. There will be discussions of the interpretation of molecular spectroscopic data as well as methods for obtaining such data. In addition, there will be sessions devoted to those phases of spectroscopy of current interest. A dormitory will be available for those who wish to reside on the campus during the meeting. For further information, or for a copy of the program when it becomes available, write to Professor H. H. Nielsen, Department of Physics and Astronomy, The Ohio State University, Columbus 10, Ohio.

Transfer to Graduateship

Student members who have now obtained degrees are reminded of the requirement of By-Law 33 which states that :

"A student shall cease to be a student at the end of the year in which he becomes eligible for transfer to the grade of Graduate . . . unless the Board upon the receipt of a written application from him allows him to remain a student."

To be eligible for transfer to Graduateship a candidate must (i) have reached the age of 21 years, (ii) have received a general education approved by the Board, (iii) have obtained a degree or diploma recognized by the Board or have passed the Institute's Graduateship Examination, and (iv) be at the time of his application engaged in research, teaching or industrial or other work or advanced study which, in the opinion of the Board, demands sufficient knowledge of physics.

Forms of application for transfer to Graduateship may be obtained from the Deputy Secretary.

Conference on Particle Size Analysis

Members are reminded that application to attend the conference on the Physics of Particle Size Analysis which is to be held in Nottingham on April 6 to 9 next, should be returned to the Secretary of the Institute by February 15. Residential accommodation is available. The papers to be read at the conference may be obtained as pre-prints by those attending ; it is not possible to supply them to others. The proceedings of the conference will be published by the Institute as a supplement to the *British Journal of Applied Physics*.

Conference on Luminescence

Applications to attend the conference on Luminescence which is to be held in Cambridge on April 7 to 10 next, should be sent by March 12. The conference is being arranged by the Electronics Group. Forms of application may be obtained from the Deputy Secretary of the Institute. Residential accommodation is available and pre-prints will be provided for those attending the conference. The proceedings will be published by the Institute as a supplement to the *British Journal of Applied Physics*.

Never lose sight of the role your particular subject has within the great performance of the tragicomedy of human life ; keep in touch with life—not so much with practical life as with the ideal background of life, which is ever so much more important ; and, keep life in touch with you. If you cannot—in the long run—tell everyone what you have been doing, your doing has been worthless.

E. SCHRÖDINGER.

REVIEWS OF BOOKS

Aesthetics and the Gestalt. By IAN RAWLINS. (Edinburgh and London : Thomas Nelson & Sons Ltd.) Pp. xi + 228 + 10 plates. Price 18s.

Ian Rawlins has been envied by many members of the Institute who care for the arts, as one of the few physicists who are actually able to earn a living and an honoured position within the opposite camp of the artistic world. We know that he is looked up to by directors of museums and galleries the world over, for his shrewdness and wisdom in calculating the kind of atmosphere, humidity, temperature, etc., which could preserve for centuries the precious relics which would otherwise decay in to-day's polluted cities. Physicists in particular will remember the paper which described, after the war, the measures he took for preservation of the National art collections.

But Rawlins has another claim, besides this technology, to being a bridge from physics to the arts, in his philosophic insight as to what is to be meant by art as well as by science. The present book is a collection of essays and reviews and lectures ; some of them are technical, for instance on the relation of measurable geometric form to aesthetic appreciation, some are historical, for instance commemorating J. J. Thomson, or the "Phil. Mag.", or a nineteenth-century discussion society. Others are entirely within art scholarship, for example on Rembrandt's technique, or Botticelli and Perugino paintings investigated by his X-ray camera at the National Gallery. But many are philosophical, and in them it is of some interest to recognize that this scientist and art critic has a profound feeling for the "worshipful" : he has the sense, not at all incompatible with science but often hidden, that there are aspects of existence which we call spiritual and cannot express in logical form.

A sole blemish in the book is its very clumsy title : English readers, especially scientists, do not react well to continental jargon with its self-conscious intellectualism. The word "Gestalt" ought to be banned as irrevocably as "existentialism."

MARTIN JOHNSON.

Sound. 5th edition. By E. G. RICHARDSON, B.A., Ph.D., D.Sc. (London : Edward Arnold & Co.). Pp. vii + 352. Price 25s.

The recent advances in applied acoustics and the increasing interest of industry in the subject have directed attention to the proper and adequate treatment of Sound in the teaching of physics at the undergraduate level. In addition the growing demand for physics graduates with a good knowledge and understanding of the basic physical principles involved in acoustical problems to assist in investigations arising in branches of aeronautical, architectural and electronic engineering

should stimulate university physics students not to neglect their studies of vibrations and sound. The overcrowded timetables of university physics courses do not, however, often allow of more than brief treatment of acoustical topics and it is important that a good textbook on sound should be available for the serious student and for reference purposes. Since its first edition in 1927 and through subsequent revised editions Dr. Richardson's excellent textbook has amply fulfilled the requirements of the university physics student and has provided the research worker and technician with up-to-date background information. Dr. Richardson is internationally recognized as a leading research worker in acoustics and allied fields and he takes an active part in the promotion of acoustical studies. It is therefore not surprising to find that though the outward appearance of the fifth edition of his book seems little different from the previous edition considerable re-arrangement of the text has been made and a considerable quantity of new material has been added. The subject matter has been toned up and copious references to original papers have been provided. The latter are now grouped at the ends of the chapters. Recent work is given adequate mention but some readers may consider that too much space is devoted to historical and outmoded, though considerably interesting, investigations. The student and teacher will regret the absence of examination questions and numerical examples. It is doubtful whether the hints given for making demonstration apparatus, e.g. an ultrasonic oscillator on p. 251, are sufficiently detailed to be useful. Perhaps it is better to recommend the use of commercial apparatus of which there are now suitable types. Nevertheless the references to such demonstrations and laboratory experiments are valuable because they indicate that the introduction of fresh acoustical experiments to supplement the classical sonometer, Kundt's tube and Melde's experiments is quite feasible and does not involve great expense.

S. WEINTROUB.

Radioactivity and Radioactive Substances. 4th edition. By SIR JAMES CHADWICK, D.Sc., LL.D., F.R.S. Revised and supplemented by Prof. J. ROTBLAT, M.A., D.Sc., F.Inst.P. (London: Sir Isaac Pitman & Sons Ltd.). Pp. 120. Price 12s. 6d.

It is of interest to note how much of the material which appeared in the first edition of this book has earned its place in the present edition. The treatment follows very closely that of the earlier editions with the addition of a new section in chapter 3 on methods of measurement, the expansion of an earlier section on γ -rays into a whole chapter, and the provision of an entirely new chapter on nuclear structure.

For a "clear and accurate account of radioactive phenomena," to quote Rutherford's original foreword, this book, within the scope

set, is still outstanding. It is curious, however, that a few blemishes that appeared in the very first edition have persisted in the present one. An example is the statement on page 2 that the α -particle is an atom of helium. A few new ones have also crept in, for example, in the Appendix on page 116 Avogadro's number is defined as the number of molecules per cubic centimetre in a gramme-molecule of a substance. Nevertheless this is a valuable little book, and Professor Rotblat is to be complimented on its production.

J. THEWLIS.

The Art of Scientific Investigation. 2nd edition. By W. I. B. BEVERIDGE. (London: W. Heinemann, Ltd.). Pp. 166. Price 10s. 6d.

Though this book is written by an eminent biologist, no excuse is necessary for bringing it to the attention of physicists; the principles with which Prof. Beveridge is concerned are common to all branches of science. In the preface he seems to imply that he is writing mainly for the benefit of the young scientist who is a beginner in research, but the book will be enjoyed by research workers and scientists of all ages. They will find it very readable and stimulating. It will appeal also to those concerned with the planning and direction of research, because of its attention to the nature and strategy of the subject, and to the essential attributes of the good research worker.

The main argument of the book is that research is a creative activity making a great demand on imagination and intuition. This being so, the research worker needs the emotional sensitivity characteristic of the creative artist, in addition to the more obvious requirements, such as insatiable curiosity and perseverance. Reason and logic, the book claims, though by no means unimportant, are the rules for examining the usefulness of the ideas arising by intuition, and for planning experiments, interpreting results, forming generalisations and proceeding to test their value. Discoveries either of fact or theory are rarely reached by reasoning. "Research can be planned but discovery cannot." Discoveries of fact are frequently made by chance. Numerous examples are quoted, including several in the physical sciences, in the course of work by Galvani (a physiologist), Oersted, and Röntgen. Prof. Beveridge emphasizes that this can happen only if the powers of observation are well trained, if the mind has the ability to interpret the observations, if the restrictive influence of existing hypotheses is minimized, and after experience has been gained enabling promising clues to be picked out. The scientist has to act both as detective and judge, finding the important clues and assessing the value of the conclusions which can be drawn when the evidence has been obtained. The frustrations only too familiar to the practising

scientist are not overlooked, and reference is made to the possibility of neuroses following the recurrent setbacks experienced by all engaged in research.

The most important chapters for those concerned with directing research are probably those on strategy and on scientists. The former gives an excellent account of planning, team work, tactics, and of the various types of research—pure and applied, exploratory and developmental. The latter deals with the essential attributes of the scientist, with incentives and rewards, the ethics of research, and the different types of scientific mind. It is very unlikely however that anyone could restrict his reading of this book to these two chapters; it is simpler to start at the beginning and enjoy all of it.

D. A. WRIGHT.

Mechanics of Materials. By E. P. POPOV. (London : Macdonald & Co. Ltd.) Pp. xiv + 228 + 10 plates. Price 70s.

This text-book is the third in what promises to be a distinguished series of engineering text-books published in the United States by Prentice-Hall. It deals with the fundamentals of the subject most commonly called Strength of Materials and should prove to be a most valuable book to the engineering undergraduate. All the usual ground is covered : stress, strain, axial loading, bending of beams, torsion, compound stresses, analysis of stress and strain, deflection of beams, statical indeterminacy, columns, connections and thick-walled cylinders.

The presentation is very lucid, and many parts of the book are a joy to read ; the illustrations are numerous and very clear ; the examples are often striking and nearly always to the point. Some of the ways in which the contents of this book differ from similar text-books is the omission of the Reciprocal Theorem, and the substitution of Virtual Work methods for the energy methods associated with the name of Castigliano. In common with most American text-books no mention is made of Macaulay's method for dealing with the difficulties caused by discontinuities in the solution of the differential equation for the deflection of a beam.

Dr. Popov, who is an associate professor of civil engineering in the University of California has added an excellent text-book to the large number of often rather ordinary texts on this subject. Whether the book will find its way on to the bookshelves of many undergraduate students of engineering at the price of seventy shillings is, unfortunately, very doubtful.

E. K. FRANKL.

Into Space. By P. E. CLEATOR. (London : Allen & Unwin Ltd.) Pp. 159. Price 15s.

Mr. Cleator is in the very strong position of a prophet who can point to developments which tend in the direction of fulfilment of his

prophecies. As he reminds us frequently in the present volume, his activities and writings of twenty years ago were received with contempt in almost all official and scientific circles. The Interplanetary Society which he founded was the butt not only for cartoonists, but for the lighter moments in scientific journals. Since then, the rockets which he postulated as a necessary basis have come much nearer practical realization, and it is no longer possible to dismiss rocket propulsion as unfounded nonsense.

Perhaps even more impressive however than the strictly technical developments which contribute to the strength of Mr. Cleator's present position is the atmosphere in which he now writes. As distinct from twenty years ago Mr. Cleator writes for a lay public which is already sold on the idea of space travel, and for a scientific public which is already aware of, and some of it actively occupied with, extensive research on rocket propellants and possible nuclear fuels. He must therefore be forgiven for the fact that his attitude throughout is—"I told you so and I am telling you again."

In technical problems, Mr. Cleator is not by any means a careless enthusiast. He gives a very careful discussion not only of the difficulties of propulsion and control of the spaceship itself, but gives serious examination, without undue optimism, of the biological difficulties too. On almost all the questions that arose out of my non-specialist ignorance, Mr. Cleator's text gave either satisfactory or plausible answers. But one point appears worthy of comment. He mentions the difficulty of drinking from a glass and says that intending voyagers will have to resign themselves to imbibing through a tube. Now, it seems to me that the liquid state itself, as we experience it, is dependent entirely on the presence of a gravitational field. One sometimes wonders whether this factor has been given sufficient attention, in theories of the liquid state. It is true that one may provide, by appropriate pressure and temperature, the necessary thermodynamic conditions for a phase intermediate between vapour and solid, but in the absence of a gravitational field, there would seem to be no reason to expect *bulk* liquid except for such retention of form as the mutual attraction would permit. For the condition of bulk liquid to exist, thermodynamic considerations alone would not appear to be enough. It would appear therefore that Mr. Cleator's space travellers will have to use spinning drinking vessels in order to provide centrifugal formation of bulk liquid.

The chief feature which strikes me in reading Mr. Cleator's book, however, is not the technical problems nor the difficulties and possibilities of achieving them. It is the impression of a most disturbing bitterness which the author injects into his book in quite unnecessary fashion. In his prologue for example, he refers to "the bigoted

minions of God." Elsewhere he refers to—"Ordinary Truth, i.e., the probable errors of to-morrow, and Holy Truth, i.e., the errors of yesterday; not yet abandoned," and to the "time-dishonoured make-believe of the theologians." At another point, he mentions that early answers to the construction of the universe were magical, and still form the basis of "primitive and improbable cosmogonies. Such myths, however, no longer command serious attention." He gives a footnote there which reads—"For example, 'and in the beginning God created the heaven and the earth'." Such bitter, but not really very biting, statements occur quite gratuitously and intrude into whatever subject he is discussing. Thus for example, when he is dealing with the quite important problem of morale of a spaceship company, he asks the reader to imagine the disastrous effect of a crew being—"stuck with a captain who snored in his sleep or noisily sucked his teeth, or suffered from halitosis and B.O., or gave periodic recitations from *Holy Writ*." The italics are mine. Mr. Cleator seems to have such a pathological hatred of religion that it must obtrude even here, and, along with unpleasant personal habits, he must rank reading of scripture—which in the past has sustained many an adventurous and pioneering captain and explorer.

While I cannot claim to hold any special brief for organized religion, I do feel that it is most disturbing that a mind which shows such great keenness to explore the universe should have so little sense of reverence. In this respect, Mr. Cleator's ideas seem exceedingly confused. Another, and in itself more welcome, characteristic attitude of his is to deplore the application of the means whereby he would travel into space, to the military purposes of devastation and slaughter. He protests against the trend of view which sees the primary possibilities of space travel as national strategic considerations in relation to, say, occupation of the moon or of space stations. Towards the end of his book he mentions this and then invites us to "Consider the homicidal antics of this bellicose mammal during the past decade, and then ask yourself what prospects the future holds. The outlook, without doubt, is grim." He imagines men emphasizing their demands on the Martians, by means of "Such indispensable accoutrements of their civilization as sub-machine guns, tanks, poison gas, atom bombs, and Holy Bibles galore."

Now one feels that Mr. Cleator might have noticed that these "homicidal antics" during the past decade seem to be largely the result of an attitude of mind which would employ all scientific developments for all kinds of purposes whatever without heed to considerations of ethics or of reverence. He might reasonably deduce that if all men, theologians included, pursued their investigations with a little more sense of reverence and of ultimate ethical responsibility, they might

then be fit not only to voyage through space, but even to live on the surface of the globe. I am, in any case, equally appalled by the prospect of space travel being conducted by minds so embittered as Mr. Cleator's, as by it being conducted according to the machinations of international politics.

To end, we may return to a technical note. The reviewer feels that despite the space travel hopefulness of the rising generation, it is somewhat impracticable to consider the possibility of our adapting ourselves to living in the atmospheric conditions of other planets before we have yet succeeded in adapting ourselves to the atmospheric conditions of the limits of our own earth's surface. When we are able to build dwelling places and ships which are so pressurised and heated that we can have favourable holidays at the Poles or on upper slopes of Everest, we may be one practical step nearer space travel for the many. Meanwhile, Mr. Cleator's picture is stimulating, it is readable, it is technically competent, but one wishes he were not so defiant about it.

R. S. SILVER.

THE REGISTER

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An asterisk (*) indicates transfer from another grade

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The National Coal Board invite applications for a number of senior appointments at their **Central Research Establishment, Isleworth, Middlesex**. This establishment is undertaking research into the underground problems arising in the mining of coal, from winning it at the coal-face to its arrival at the surface. The posts to be filled will be concerned with (a) an intensive fundamental examination of the mechanical properties of coal and the forces required to break it; (b) study of the fundamental principles of methods of getting coal from the seam, including cutting and ploughing, with the aim of devising new and improved methods; (c) application of the fundamental knowledge gained in (a) and (b) above to the design of experimental machinery and the metallurgical problems involved in this and other mining practice; (d) fundamental study of the problems associated with the mining of coal including the conveying of coal by belts, the control and measurement of methane and dust and the measurement of stresses in coal and rock strata; (e) study of colliery electrical devices and systems, design of instruments for experimental work in the laboratory and in collieries, and design of instruments for day-to-day use underground in collieries, including the measurement of dustiness and the detection of methane.

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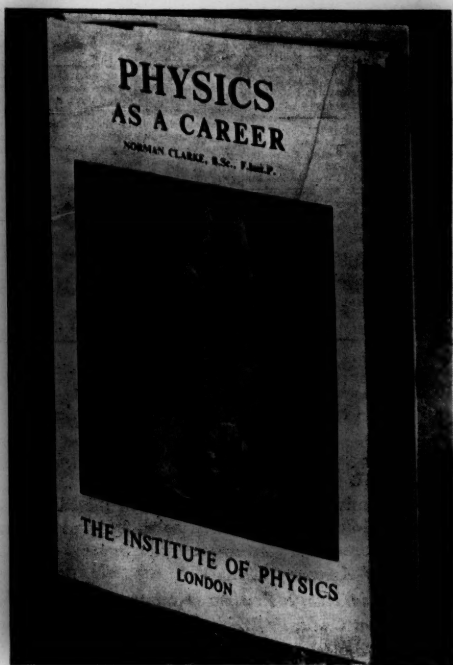
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- Measurements at Centimeter Wavelength* (King);
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